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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fifth Semester, B.E. –Automobile Engineering

Semester End Examination; Dec – 2017 / Jan - 2018

Design of Machine Elements - I

Time: 3 hrs *Max. Marks: 100*

***Note**: i)* Answer ***FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Use of design data book is permitted.

UNIT - I

1 a. Define factor and safety. What are the criteria used for the selection of factor of safety is design? 5

b. A machine member of 50 mm diameter by 250 mm long is supported at one end as a cantilever and the other end is subjected to;

i) Bending load of 3000 N and torsional moment of 1000 Nm 15

ii) Torsional moment of 1000 Nm and axial load of 15000 N as shown in Fig. 1(a) and (b). Determine the maximum normal stress and the maximum shear stress.

2 a. Explain briefly any two theories of failure. 4

b. A bar of 12 mm diameter stretched by 30 mm under a steady load of 8 kN. What stress would be produced in the bar by a weight of 800 N which falls through 80 mm before commencing the stretching of the rod which is initially in stressed? 6

Assume $E = 2x10^5$ N/mm^2.

c. A shaft of 50 mm diameter subjected to an axial load of 20 kN and a torque of 1.5 kNm. The yield stress of material in simple tension is 320 N/mm^2. Determine the FOS based on any two theories of failure. 10

UNIT - II

3 a. What is stress concentration? What are the means of reducing stress concentration? 5

b. Write a note on fatigue failure and endurance unit. 5

c. Determine the thickness of a filleted plate subjected to a tensile load of 5 kN as shown in Fig. 3(c) the ultimate strength of the plate material is 200 MPa. Take a factor of safety as 2.5. 10

4 a. Derive a Soderberg equation. 6

b. A cantilever beam Fig. 4(b) made of cold drawn carbon steel (σ_u = 550 MPa, σ_y = 470 MPa, σ_{cn} = 275 MPa) of circular cross section is subjected to load which carries from –F to 3F. Determine the maximum load that this member can withstand for an indefinite life using a factor of safety of 2. 14

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UNIT - III

5. Design a cast iron flange coupling for a mild steel shaft transmitting 90 kW at 250 rpm the allowable shear stress in the shaft is 40 MPa. The allowable shear stress in the coupling bolt is 30 MPa and is cast iron is 15 MPa. 20

6. A shaft is supported by two bearings placed 1100 mm apart. A pulley of diameter 620 mm is keyed at 400 mm to the right from the left hand bearing and this drives a pulley directly below it, with a maximum tension of 2.75 kN. Another pulley of diameter 400 mm is placed 200 mm to the left of right hand bearing and is driven with a motor placed horizontally to the right. The angle of contact of the pulleys is 180º and $\mu = 0.3$ Find the diameter of the shaft. 20

Assume $C_m = 3.0$, $C_t = 2.5$, $\sigma_y = 190$ MPa, $\sigma_u = 300$ MPa.

UNIT - IV

7 a. Explain in details the various modes of failure of a riveted joint with neat sketches. 6

b. Design a triple riveted longitudinal double strap bolt joint with unequal straps for a boiler. The inside diameter of boiler drum is 1.3 m. The internal pressure in the boiler shell is 2.4 N/mm^2. Take the working stress as; 14

$\sigma_t = 77\ N/mm^2$, $\tau = 62\ N/mm^2$,and $\sigma_c = 120\ N/mm^2$, assume efficiency of joint as 81%.

8a. Two steel plates 100 mm wide and 12 mm thick are to be joined by double transverse fillet weld the maximum tensile stress is not to exceed 70 MPa. Find the length of the weld for static and dynamic loading. 8

b. A bracket to supporting load P = 3000 N is welded to a vertical member by a four fillet welds as shown in Fig. 8(b). Calculate the size of the weld if the stress in the throat section is not exceeding 85 MPa. 12

UNIT - V

9 a. Discuss the significance of initial tightening load and the applied load so for as both are concerned. 5

b. Name the different types of screw thread. Illustrate any one type of screw thread with a diagram. 5

c. A bracket shown in Fig. 9(c) carries a load of 50 kN. Determine the size of the bolt of the permissible tensile stress in the bolt material is 200 N/mm^2 10

10 a. Obtain an equation for the torque required to lift the load on square threaded screw. 6

b. A power screw has a major diameter of 32 mm, a pitch of 4 mm with double threads and is to be used in small power press operated by power screws. The given data include coefficient of friction = 0.08, mean diameter of collar = 40 mm and W= 6.4 kN per screw.

i) Find the thread depth, thread width, mean or pitch diameter, minor diameter and lead

ii) Find the torque required to rotate the screw to against the load 14

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iii) Find the torque required to rotate the screw to lower the load

iv) Find the overall efficiency

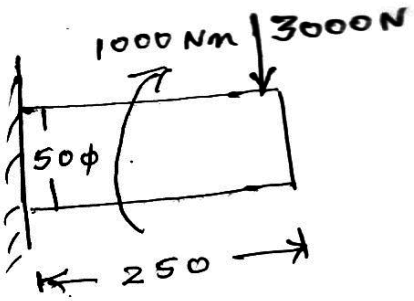

Fig 1(a)

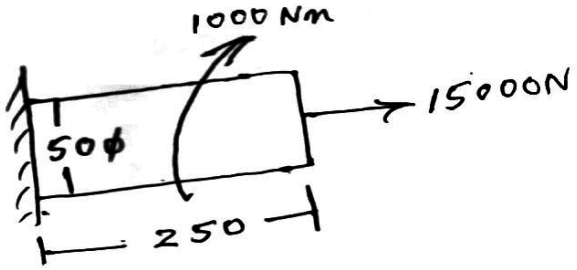

Fig 1(b)

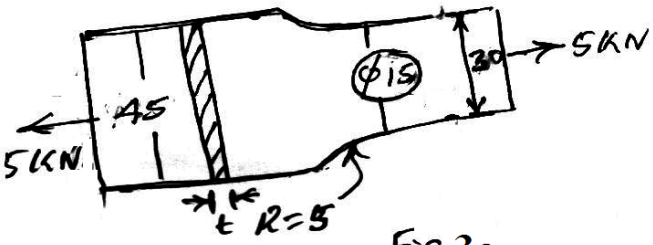

Fig 3c

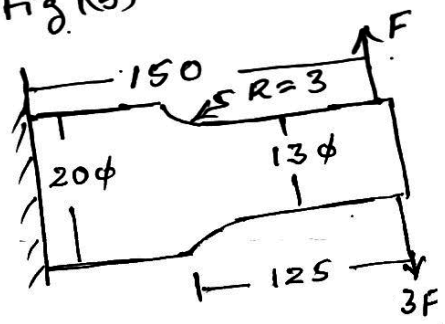

Fig 4b

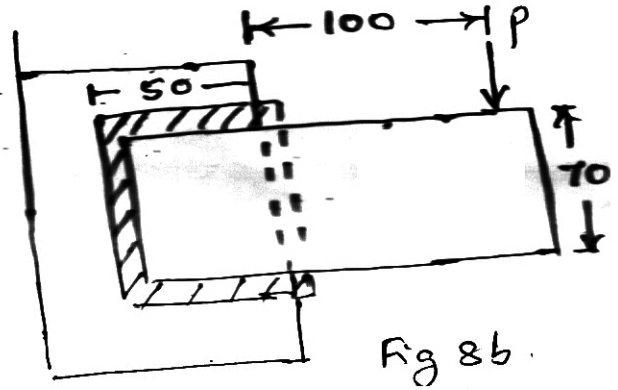

Fig 8b

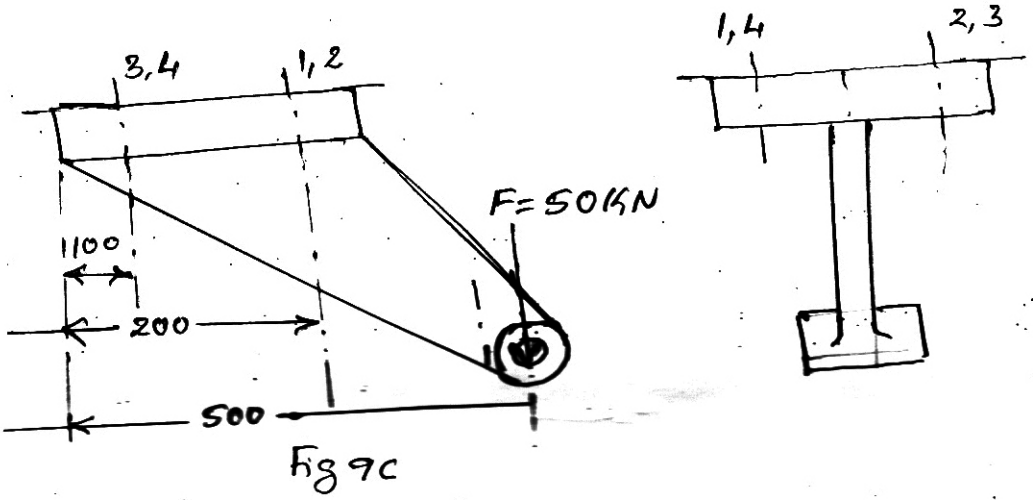

Fig 9c

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